**Supplementary Table 1** Frequencies of recurrence/metastasis in each histological subtype

|                | WMDA       | PDA        | MUA        | SRCC       |
|----------------|------------|------------|------------|------------|
| *Recurrence (%)* | 37/152 (24.3%) | 34/98 (34.7%) | 15/64 (23.4%) | 3/9 (33.3%) |
| RR (95%CI)     | Reference  | 1.425 (0.963-2.094) | 0.963 (0.563-1.592) | 1.369 (0.479-2.821) |
| **p** value    |            | 0.086      | 1.000      | 0.691      |

*In this study cohort, there were no cases of local recurrence throughout the histological subtypes. Therefore, recurrence means distant metastasis due to hematogenous/lymphatic metastasis or peritoneal dissemination. **Statistical analysis was performed by Fisher's exact test. WMDA well-to-moderately differentiated adenocarcinoma, PDA poorly differentiated adenocarcinoma, MUA mucinous adenocarcinoma, SRCC signet-ring cell carcinoma, RR relative risk, CI confidence interval.*
Supplementary Table 2  Clinicopathologic characteristics of node-negative WMDA according to degree of venous invasion

| Parameter                        | Degree of venous invasion | Total  | \(^*p\) value |
|----------------------------------|---------------------------|--------|---------------|
|                                 | v0 (n = 53)   | v1 (n = 32) | v2 (n = 9) | (n = 94) | v0 vs. v1 | v0 vs. v2 |
| Age                             |                        |        |               |
| \(\geq 65\)                      | 40                      | 19      | 6            | 65       | 0.148     | 0.683     |
| < 65                             | 13                      | 13      | 3            | 29       |           |           |
| Gender                           |                          |        |               |
| Male                             | 34                      | 19      | 9            | 62       | 0.818     | 0.047     |
| Female                           | 19                      | 13      | 0            | 32       |           |           |
| Family history of CRC            |                          |        |               |
| Yes                              | 3                       | 1       | 0            | 4        | 1.000     | 1.000     |
| No                               | 50                      | 31      | 9            | 90       |           |           |
| Location                         |                          |        |               |
| Left-sided                       | 36                      | 26      | 6            | 68       | 0.215     | 1.000     |
| Right-sided                      | 17                      | 6       | 3            | 26       |           |           |
| Depth of invasion                |                          |        |               |
| pTis/pT1/pT2                     | 24                      | 10      | 2            | 36       | 0.255     | 0.282     |
| pT3/pT4                          | 29                      | 22      | 7            | 58       |           |           |
| Postoperative chemotherapy       |                          |        |               |
| Yes                              | 7                       | 6       | 3            | 16       | 0.543     | 0.151     |
| No                               | 46                      | 26      | 6            | 78       |           |           |
| Postoperative radiation          |                          |        |               |
| Yes                              | 0                       | 0       | 1            | 1        | 1.000     | 0.145     |
| No                               | 53                      | 32      | 8            | 93       |           |           |

*\(^*p\) value calculated by Fisher's exact test. WMDA well-to-moderately differentiated adenocarcinoma, CRC colorectal cancer, v0 no venous invasion, v1 1-3 invasions/glass slide, v2 4-6 invasions/glass slide, v3 \(\geq 7\) invasions/glass slide. Filling type of venous invasion in macroscopically identifiable vein with a minor axis of \(\geq 1\) mm raised the grade of a v1 or v2 by 1.
**Supplementary Table 3** Clinicopathologic characteristics of node-positive WMDA according to degree of venous invasion

| Parameter                        | Degree of venous invasion | Total (n = 58) | \(^p\) value |
|----------------------------------|---------------------------|----------------|--------------|
|                                  | v0 (n = 16) | v1 (n = 24) | v2 (n = 14) | v3 (n = 4) | \(v0\) vs. \(v1\) | \(v0\) vs. \(v2\) | \(v0\) vs. \(v3\) |
| Age                              |              |              |              |              |                   |                   |               |
| ≥ 65                             | 11           | 13           | 9            | 2            | 35                 | 0.512            | 1.000         | 0.587         |
| < 65                             | 5            | 11           | 5            | 2            | 23                 |                   |               |               |
| Gender                           |              |              |              |              |                   |                   |               |               |
| Male                             | 12           | 11           | 8            | 2            | 33                 | 0.104            | 0.442         | 0.549         |
| Female                           | 4            | 13           | 6            | 2            | 25                 |                   |               |               |
| Family history of CRC            |              |              |              |              |                   |                   |               |               |
| Yes                              | 1            | 1            | 1            | 0            | 3                  | 1.000            | 1.000         | 1.000         |
| No                               | 15           | 23           | 13           | 4            | 55                 |                   |               |               |
| Location                         |              |              |              |              |                   |                   |               |               |
| Left-sided                       | 13           | 14           | 9            | 3            | 39                 | 0.177            | 0.417         | 1.000         |
| Right-sided                      | 3            | 10           | 5            | 1            | 19                 |                   |               |               |
| Depth of invasion                |              |              |              |              |                   |                   |               |               |
| pTis/pT1/pT2                     | 1            | 3            | 0            | 0            | 4                  | 0.638            | 1.000         | 1.000         |
| pT3/pT4                          | 15           | 21           | 14           | 4            | 54                 |                   |               |               |
| Postoperative chemotherapy        |              |              |              |              |                   |                   |               |               |
| Yes                              | 9            | 13           | 11           | 3            | 36                 | 1.000            | 0.260         | 0.619         |
| No                               | 7            | 11           | 3            | 1            | 22                 |                   |               |               |
| Postoperative radiation           |              |              |              |              |                   |                   |               |               |
| Yes                              | 0            | 1            | 2            | 1            | 4                  | 1.000            | 0.209         | 0.200         |
| No                               | 16           | 23           | 12           | 3            | 54                 |                   |               |               |

*Statistical analysis was performed by Fisher's exact test. WMDA well-to-moderately differentiated adenocarcinoma, CRC colorectal cancer, \(v0\) no venous invasion, \(v1\) 1-3 invasions/glass slide, \(v2\) 4-6 invasions/glass slide, \(v3\) ≥7 invasions/glass slide. Filling type of venous invasion in macroscopically identifiable vein with a minor axis of ≥ 1 mm raised the grade of a \(v1\) or \(v2\) by 1.
**Supplementary Table 4** Clinicopathologic characteristics of node-negative PDA according to degree of venous invasion

| Parameter                   | Degree of venous invasion | Total (n = 31) | \(p\) value | \(p\) value |
|-----------------------------|---------------------------|----------------|-------------|-------------|
|                             | v0 (n = 11)               | v1 (n = 15)    | v2+v3 (n = 5)| v0 vs. v1  | v0 vs. v2+v3|
| Age                         |                           |                |             |             |             |
| \(\geq 65\)                | 9                         | 10             | 1           | 20          | 0.658       | 0.036 |
| < 65                        | 2                         | 5              | 4           | 11          |             |        |
| Gender                      |                           |                |             |             |             |        |
| Male                        | 3                         | 9              | 3           | 15          | 0.130       | 0.299 |
| Female                      | 8                         | 6              | 2           | 16          |             |        |
| Family history of CRC       |                           |                |             |             |             |        |
| Yes                         | 0                         | 0              | 0           | 0           | 1.000       | 1.000 |
| No                          | 11                        | 15             | 5           | 31          |             |        |
| Location                    |                           |                |             |             |             |        |
| Left-sided                  | 3                         | 4              | 5           | 12          | 1.000       | 0.026 |
| Right-sided                 | 8                         | 11             | 0           | 19          |             |        |
| Depth of invasion           |                           |                |             |             |             |        |
| pTis/pT1/pT2                | 0                         | 2              | 2           | 4           | 0.492       | 0.083 |
| pT3/pT4                     | 11                        | 13             | 3           | 27          |             |        |
| Postoperative chemotherapy  |                           |                |             |             |             |        |
| Yes                         | 2                         | 4              | 3           | 9           | 1.000       | 0.251 |
| No                          | 8                         | 11             | 2           | 21          |             |        |
| Unknown                     | 1                         | 0              | 0           | 1           |             |        |
| Postoperative radiation     |                           |                |             |             |             |        |
| Yes                         | 1                         | 0              | 0           | 1           | 0.400       | 1.000 |
| No                          | 9                         | 15             | 5           | 29          |             |        |
| Unknown                     | 1                         | 0              | 0           | 1           |             |        |

*Statistical analysis was performed by Fisher's exact test. PDA poorly differentiated adenocarcinoma, CRC colorectal cancer, v0 no venous invasion, v1 1-3 invasions/glass slide, v2 4-6 invasions/glass slide, v3 \(\geq 7\) invasions/glass slide. Filling type of venous invasion in macroscopically identifiable vein with a minor axis of \(\geq 1\) mm raised the grade of a v1 or v2 by 1.
### Supplementary Table 5 Clinicopathologic characteristics of node-positive PDA according to degree of venous invasion

| Parameter                      | Degree of venous invasion | Total (n = 67) | p value |
|--------------------------------|---------------------------|----------------|---------|
|                                | v0 (n = 7) | v1 (n = 37) | v2 (n = 14) | v3 (n = 9) | v0 vs. v1 | v0 vs. v2 | v0 vs. v3 |
| Age                            |              |              |              |              |          |          |          |
| ≥ 65                           | 3           | 27           | 9           | 4           | 43       | 0.184    | 0.397    | 1.000    |
| < 65                           | 4           | 10           | 5           | 5           | 24       |          |          |          |
| Gender                         |              |              |              |              |          |          |          |
| Male                           | 3           | 18           | 8           | 3           | 32       | 1.000    | 0.659    | 1.000    |
| Female                         | 4           | 19           | 6           | 6           | 35       |          |          |          |
| Family history of CRC          |              |              |              |              |          |          |          |
| Yes                            | 0           | 0            | 0           | 1           | 1        | 1.000    | 1.000    | 1.000    |
| No                             | 7           | 37           | 13          | 8           | 65       |          |          |          |
| Unknown                        | 0           | 0            | 1           | 0           | 1        |          |          |          |
| Location                       |              |              |              |              |          |          |          |
| Left-sided                     | 4           | 13           | 7           | 4           | 28       | 0.402    | 1.000    | 1.000    |
| Right-sided                    | 3           | 24           | 7           | 5           | 39       |          |          |          |
| Depth of invasion              |              |              |              |              |          |          |          |
| pTis/pT1/pT2                   | 1           | 0            | 0           | 0           | 1        | 0.159    | 0.333    | 0.438    |
| pT3/pT4                        | 6           | 37           | 14          | 9           | 66       |          |          |          |
| Postoperative chemotherapy     |              |              |              |              |          |          |          |
| Yes                            | 4           | 21           | 7           | 7           | 39       | 1.000    | 0.642    | 1.000    |
| No                             | 2           | 16           | 7           | 2           | 27       |          |          |          |
| Unknown                        | 1           | 0            | 0           | 0           | 1        |          |          |          |
| Postoperative radiation        |              |              |              |              |          |          |          |
| Yes                            | 0           | 1            | 0           | 0           | 1        | 1.000    | 1.000    | 1.000    |
| No                             | 6           | 36           | 14          | 9           | 65       |          |          |          |
| Unknown                        | 1           | 0            | 0           | 0           | 1        |          |          |          |

*Statistical analysis was performed by Fisher's exact test. PDA poorly differentiated adenocarcinoma, CRC colorectal cancer, v0 no venous invasion, v1 1-3 invasions/glass slide, v2 4-6 invasions/glass slide, v3 ≥7 invasions/glass slide. Filling type of venous invasion in macroscopically identifiable vein with a minor axis of ≥1 mm raised the grade of a v1 or v2 by 1.
**Supplementary Table 6** Clinicopathologic characteristics of node-negative MUA according to degree of venous invasion

| Parameter                                | Degree of venous invasion | Total (n = 37) | *p value |
|------------------------------------------|---------------------------|----------------|----------|
|                                          | v0 (n = 24)               | v1 (n = 13)    | v0 vs. v1 |
| Age                                      |                           |                |          |
| ≥ 65                                     | 17                        | 9              | 26       | 1.000    |
| < 65                                     | 7                         | 4              | 11       |          |
| Gender                                   |                           |                |          |
| Male                                     | 20                        | 8              | 28       | 0.229    |
| Female                                   | 4                         | 5              | 9        |          |
| Family history of CRC                    |                           |                |          |
| Yes                                      | 2                         | 1              | 3        | 1.000    |
| No                                       | 21                        | 12             | 33       |          |
| Unknown                                  | 1                         | 0              | 1        |          |
| Location                                 |                           |                |          |
| Left-sided                               | 13                        | 5              | 18       | 0.495    |
| Right-sided                              | 11                        | 8              | 19       |          |
| Depth of invasion                        |                           |                |          |
| pTis/pT1/pT2                             | 4                         | 0              | 4        | 0.276    |
| pT3/pT4                                  | 20                        | 13             | 33       |          |
| Postoperative chemotherapy               |                           |                |          |
| Yes                                      | 4                         | 4              | 8        | 0.433    |
| No                                       | 18                        | 9              | 27       |          |
| Unknown                                  | 2                         | 0              | 2        |          |
| Postoperative radiation                  |                           |                |          |
| Yes                                      | 3                         | 0              | 3        | 0.279    |
| No                                       | 19                        | 13             | 32       |          |
| Unknown                                  | 2                         | 0              | 2        |          |

*Statistical analysis was performed by Fisher’s exact test. MUA mucinous adenocarcinoma, CRC colorectal cancer, v0 no venous invasion, v1 1-3 invasions/glass slide, v2 4-6 invasions/glass slide, v3 ≥7 invasions/glass slide. Filling type of venous invasion in macroscopically identifiable vein with a minor axis of ≥ 1 mm raised the grade of a v1 or v2 by 1.
### Supplementary Table 7 Clinicopathologic characteristics of node-positive MUA according to degree of venous invasion

| Parameter                        | Degree of venous invasion (n = 26) | Total | \(^*p\) value | v0 vs. v1 | v0 vs. v2 |
|----------------------------------|-----------------------------------|-------|---------------|-----------|-----------|
|                                  | v0 (n = 9) | v1 (n = 13) | v2 (n = 4) |          |           |
| Age                              |          |            |            |          |           |
| ≥ 65                             | 6 | 9 | 3 | 18 | 1.000 | 1.000 |
| < 65                             | 3 | 4 | 1 | 8 | 0.384 | 0.559 |
| Gender                           |          |            |            |          |           |
| Male                             | 5 | 8 | 1 | 14 | 1.000 | 0.559 |
| Female                           | 4 | 5 | 3 | 12 | 1.000 | 1.000 |
| Family history of CRC            |          |            |            |          |           |
| Yes                              | 1 | 0 | 0 | 1 | 0.409 | 1.000 |
| No                               | 8 | 13 | 4 | 25 | 0.409 | 1.000 |
| Location                         |          |            |            |          |           |
| Left-sided                       | 4 | 9 | 1 | 14 | 0.384 | 1.000 |
| Right-sided                      | 5 | 4 | 3 | 12 | 1.000 | 1.000 |
| Depth of invasion                |          |            |            |          |           |
| pTis/pT1/pT2                     | 1 | 0 | 1 | 2 | 0.409 | 1.000 |
| pT3/pT4                          | 8 | 13 | 3 | 24 | 0.409 | 1.000 |
| Postoperative chemotherapy       |          |            |            |          |           |
| Yes                              | 5 | 7 | 2 | 14 | 1.000 | 1.000 |
| No                               | 4 | 5 | 2 | 11 | 1.000 | 1.000 |
| Unknown                          | 0 | 1 | 0 | 1 | 1.000 | 1.000 |
| Postoperative radiation          |          |            |            |          |           |
| Yes                              | 0 | 0 | 0 | 0 | 1.000 | 1.000 |
| No                               | 9 | 12 | 4 | 25 | 1.000 | 1.000 |
| Unknown                          | 0 | 1 | 0 | 1 | 1.000 | 1.000 |

*Statistical analysis was performed by Fisher's exact test. MUA mucinous adenocarcinoma, CRC colorectal cancer, v0 no venous invasion, v1 1-3 invasions/glass slide, v2 4-6 invasions/glass slide, v3 ≥7 invasions/glass slide. Filling type of venous invasion in macroscopically identifiable vein with a minor axis of ≥ 1 mm raised the grade of a v1 or v2 by 1.