Supplementary Information for

The esophageal gland mediates host immune evasion by the human parasite *Schistosoma mansoni*

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Other supplementary materials for this manuscript include the following:

- Movies S1 to S2
Fig. S1. Stem cell-driven differentiation of host-parasite interfaces in schistosomula. (A) Scheme of using mechanically transformed in vitro schistosomula and in vivo lung-stage schistosomula for EdU pulse-chase experiments. (B) Number of h2b+ EdU+ (left) and tsp2+ EdU+ (right) double-positive cells as percentages of total single-positive populations in in vitro schistosomula pulsed with EdU D0-D4 and chased until D6. Mean ± sd. Statistical analysis: Welch’s t-test. (C) Number of h2b+ EdU+ (green) and tsp2+ EdU+ (magenta) cells as a percentage of total h2b+ or tsp2+ cells (left) or total EdU+ cells (right) from in vivo schistosomula. Mean ± sd. N: number of worms analyzed. (D) Expression of tsp2 mRNA (marker of tegument progenitors) in cercariae, detected by FISH (maximum-intensity projection). (E) Quantification of tsp2+ cells from cercariae and schistosomula harvested at the indicated time points. Each dot represents a single worm. Mean ± sd. Statistical analysis: one-way ANOVA followed by Tukey’s multiple comparisons test. (F) Quantification of cathepsin B+ cells from cercariae and schistosomula harvested at indicated time points. Each dot represents a single worm. Median with interquartile range shown. Statistical analysis: one-way ANOVA followed by Tukey’s multiple comparisons test. (G) EdU pulse-chase experiment combined with FISH to detect cathepsin B mRNA in schistosomula that were pulsed with EdU from D7-D9 and chased until D14 (maximum-intensity projection). A magnified single confocal z-section of the boxed area is shown on the right with cathepsin B (top) and without cathepsin B (bottom). Arrows: cathepsin B+ cells.
Fig. S2. Stem cell-driven development of host-parasite interfaces in juveniles. (A) Gut...
development in juvenile schistosomes (3-weeks post-infection) as revealed by cathepsin B FISH (maximum-intensity projections). Different sizes represent different times of arrival at the hepatic portal vein, with the smallest arriving latest. Schistosomes first merge the two gut lobes in both male and female worms; branching patterns then diverge between males and females as they develop further. Asterisks: developing gonads. A: anterior; P: posterior. (B-D) Expression of cell type-specific markers by FISH in 3-week-old juvenile schistosomes (maximum-intensity projections): (B) meg4.1 (esophageal gland); (C) pla2 (esophageal anterior cell mass); and (D) tsp2 (tegument progenitors). (E-I) EdU pulse-chase experiments in juvenile schistosomes. Parasites were harvested 3-weeks post-infection from mice that received a single EdU injection between 0-7 days prior to sacrifice. (E) cathepsin B (top) and tsp2 (bottom) FISH in juvenile gut and tegument, respectively. Single confocal sections. Yellow arrowheads: cathepsin B+ EdU+ cells within the gut; red arrows: tsp2+ EdU+ cells near the tegument. (F) Quantification of cathepsin B+ EdU+ cells over total cathepsin B+ cells (magenta) and tsp2+ EdU+ cells over total tsp2+ cells (green) in juvenile parasites harvested from mice given a single EdU injection. Dotted lines indicate quantifications from adult worms for comparison to the juvenile worms. The numbers of worms and cells analyzed for each condition are listed in the box below. Mean ± sd shown. (G-I) EdU incorporation and double FISH of h2b with (G) pla2 (anterior cell mass), (H) meg4.1, or (I) tsp2, single confocal sections. Arrows: h2b+ EdU+ cells; arrowheads: lineage+ EdU+ cells; eg: esophageal gland. N=3-5 worms were analyzed for each condition.
Figure S3. Phylogenetic analysis of foxA and its esophageal gland-enriched expression. (A) Circular cladogram including all forkhead domain-containing S. mansoni Fox proteins with forkhead domains of FOX proteins extracted from multiple species. Analyzed species include
human, mouse, *D. melanogaster* (DROME), *C. elegans* (CAEEL), *S. mediterranea* (Smed), *S. cerevisiae* (Yeast), *S. pombe* (SCHPO), *X. laevis* (XENLA), *X. tropicalis* (XENTR). The numbers before each branch indicate bootstrap value (%). Magnified view of the FOXA family is shown on the right. (B) Whole-mount in situ hybridization (WISH) of foxA in adult male (left) and female (right) worms. (C) foxA FISH in less developed (left) and more developed (right) juvenile schistosomes, single confocal sections. (D) Double FISH of tsp2 and foxA in adult worms, showing co-localization of foxA with tsp2, a tegument progenitor marker (single confocal sections).
Figure S4. foxA RNAi results in esophageal gland loss, but other cell types are not affected. (A) qPCR analysis of schistosomula RNA collected after one week of exposure to foxA dsRNA. Genes known to be expressed in the esophageal gland, gut, tegument, and stem cells were tested. Mean ± sd. (B) Double FISH of h2b and tsp2 in control and foxA RNAi male juvenile parasites showing accumulation of stem cells (h2b+) and progenitor (tsp2+) near the missing esophageal gland (single confocal sections). Bracket: anatomical location of the esophageal gland. Number of worms analyzed: 17 control RNAi worms; 18 foxA RNAi worms from three independent RNAi batches. (C) foxA knockdown in adults leads to down-regulation of known esophageal gland markers. qPCR analysis of RNA isolated from adult head fragments collected after 2 weeks (5 feedings) of exposure to foxA dsRNA. Head fragments were cut posterior to the ventral sucker. Mean ± sd. (D) FISH of different cell-type markers in adult worms showing similarities in their expression patterns between control and foxA knockdown animals (maximum-intensity projections). N=9 control RNAi worms; N=12 foxA RNAi worms.
Figure S5. Characterization of stunted foxA RNAi parasites recovered after transplantation. (A) Representative brightfield images of recovered parasites 25 days post-transplantation. Note that foxA knockdown animals are shorter and thinner than control animals. (B) FISH of different cell-type markers in control and stunted foxA RNAi worms recovered from WT and Rag1<sup>−/−</sup> mice >3 weeks post-transplantation. Note that foxA RNAi worms recovered from Rag1<sup>−/−</sup> mice lack PNA lectin and have little or no expression of meg4.1, while they express cathepsin B at high levels along the thickened gut branch. Also, note a slight increase in the number of stem cells (h2b<sup>+</sup>) and progenitors (tsp2<sup>+</sup>) near the missing esophageal gland, similar to juvenile worms after foxA knockdown. Other cell-type markers are expressed at similar levels in foxA RNAi worms compared to control worms recovered from WT or Rag1<sup>+/−</sup> mice (maximum-intensity projections). Scale bars: 50µm.
Figure S6. Reproductive system regression in foxA RNAi schistosomes and reduced disease pathology in host mice. (A) Characterization of the reproductive system of control and
foxA RNAi schistosomes recovered from WT and Rag^{-/-} mice >3 weeks post-transplantation. FISH to detect h2b, which is expressed in germ cells and vitellocytes (6), in addition to stem cells (maximum-intensity projections). Scale bars: 50 µm. (B) H&E staining of liver sections recovered from WT, Rag1^{-/-}, and µMT^{-/-} mice >3 weeks after transplantation of control or foxA RNAi parasites. Note that dead worms are found in WT mice that received foxA RNAi parasites but are not found in Rag1^{-/-} and µMT^{-/-} mice. Also, note that granulomas were formed around eggs laid in livers of WT and µMT^{-/-} mice but not formed around eggs laid in livers of Rag1^{-/-} mice. Eggs were not found in any mice that received foxA RNAi parasites. Scale bars: 100 µm. (C) Percentage of foxA RNAi parasites recovered 6 days after transplantation. Mean ± sd. Statistical analysis: Unpaired t-test. (D) Length of parasites recovered 6 days after transplantation. Each dot represents a single male worm. Mean ± sd. Statistical analysis: Unpaired t-test.
Table S1. Raw data of parasite transplantation and recovery (Figure 5A)

| Experiment | Mouse Strain / Background | Mouse Genotype | Mouse Sex | Parasite age (weeks) at start of RNAi | Parasite age (weeks) | Parasite condition | Parasite condition | Days post-transplantation (days) | Days fed RNAi | % Recovery |
|------------|---------------------------|----------------|----------|--------------------------------------|----------------------|-------------------|-------------------|---------------------------------|--------------|------------|
| Exp 1 Swiss-Webster                               | wild type               | female        | 5        | pJC (control)                        | 6                    | feedings          | 15                 | 10                | 4           | 40.0       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5        | pJC (control)                        | 6                    | feedings          | 15                 | 10                | 9           | 90.0       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5        | pJC (control)                        | 6                    | feedings          | 15                 | 11                | 6           | 54.5       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5        | pJC (control)                        | 6                    | feedings          | 15                 | 12                | 1           | 8.3        |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5        | foxA                                 | 6                    | feedings          | 15                 | 9                 | 0           | 0.0        |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5        | foxA                                 | 6                    | feedings          | 15                 | 12                | 3           | 25.0       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5        | foxA                                 | 6                    | feedings          | 15                 | 8                 | 1           | 12.5       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5        | foxA                                 | 6                    | feedings          | 15                 | 9                 | 3           | 33.3       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5        | foxA                                 | 6                    | feedings          | 15                 | 3                 | 1           | 33.3       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | pJC (control)                        | 5                    | feedings          | 25                 | 9                 | 4           | 44.4       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | pJC (control)                        | 5                    | feedings          | 25                 | 11                | 5           | 45.5       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | pJC (control)                        | 5                    | feedings          | 25                 | 6                 | 3           | 50.0       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | pJC (control)                        | 5                    | feedings          | 25                 | 5                 | 4           | 80.0       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | pJC (control)                        | 5                    | feedings          | 25                 | 7                 | 3           | 42.9       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | pJC (control)                        | 5                    | feedings          | 25                 | 9                 | 7           | 77.8       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | pJC (control)                        | 5                    | feedings          | 25                 | 5                 | 1           | 20.0       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | foxA                                 | 5                    | feedings          | 25                 | 10                | 0           | 0.0        |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | foxA                                 | 5                    | feedings          | 25                 | 8                 | 2           | 25.0       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | foxA                                 | 5                    | feedings          | 25                 | 12                | 0           | 0.0        |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | foxA                                 | 5                    | feedings          | 25                 | 14                | 1           | 7.1        |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | foxA                                 | 5                    | feedings          | 25                 | 13                | 0           | 0.0        |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | foxA                                 | 5                    | feedings          | 25                 | 15                | 0           | 0.0        |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | foxA                                 | 5                    | feedings          | 25                 | 5                 | 0           | 0.0        |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | foxA                                 | 5                    | feedings          | 25                 | 6                 | 0           | 0.0        |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | foxA                                 | 5                    | feedings          | 25                 | 17                | 4           | 23.5       |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | foxA                                 | 5                    | feedings          | 25                 | 11                | 0           | 0.0        |
| Exp 1 Swiss-Webster                               | wild type               | female        | 5.5      | foxA                                 | 5                    | feedings          | 25                 | 12                | 2           | 16.7       |
| Exp 3 BL6                                           | wild type               | male          | 5        | pJC (control)                        | 6                    | feedings          | 21                 | 10                | 6           | 60.0       |
| Exp | BL6 | wild-type | male | 5 weeks | pJC (control) | 6 feedings | 21 days | 6 | 4 | 66.7 |
|-----|-----|-----------|------|---------|--------------|-----------|---------|---|---|-----|
| Exp 3 | BL6 | wild-type | male | 5 weeks | foxA | 6 feedings | 21 days | 9 | 0 | 0.0 |
| Exp 3 | BL6 | Rag1 KO | male | 5 weeks | pJC (control) | 6 feedings | 21 days | 8 | 7 | 87.5 |
| Exp 3 | BL6 | Rag1 KO | male | 5 weeks | foxA | 6 feedings | 21 days | 7 | 6 | 85.7 |
| Exp 3 | BL6 | Rag1 KO | male | 5 weeks | foxA | 6 feedings | 21 days | 8 | 1 | 12.5 |
| Exp 4 | BL6 | wild-type | male | 5 weeks | pJC (control) | 7 feedings | 22 days | 18 | 12 | 66.7 |
| Exp 4 | BL6 | wild-type | male | 5 weeks | pJC (control) | 7 feedings | 22 days | 20 | 15 | 75.0 |
| Exp 4 | BL6 | wild-type | male | 5 weeks | pJC (control) | 7 feedings | 21 days | 16 | 9 | 56.3 |
| Exp 4 | BL6 | wild-type | male | 5 weeks | pJC (control) | 4 feedings | 21 days | 16 | 9 | 56.3 |
| Exp 4 | BL6 | wild-type | male | 5 weeks | foxA | 7 feedings | 22 days | 16 | 0 | 0.0 |
| Exp 4 | BL6 | wild-type | male | 5 weeks | foxA | 7 feedings | 22 days | 9 | 3 | 33.3 |
| Exp 4 | BL6 | wild-type | male | 5 weeks | foxA | 7 feedings | 22 days | 18 | 2 | 11.1 |
| Exp 4 | BL6 | wild-type | male | 5 weeks | foxA | 7 feedings | 22 days | 18 | 1 | 5.6 |
| Exp 4 | BL6 | wild-type | male | 5 weeks | foxA | 4 feedings | 21 days | 16 | 0 | 0.0 |
| Exp 4 | BL6 | Rag1 KO | male | 5 weeks | pJC (control) | 7 feedings | 22 days | 19 | 4 | 21.1 |
| Exp 4 | BL6 | Rag1 KO | male | 5 weeks | pJC (control) | 7 feedings | 22 days | 20 | 9 | 45.0 |
| Exp 4 | BL6 | Rag1 KO | male | 5 weeks | pJC (control) | 7 feedings | 22 days | 16 | 11 | 68.8 |
| Exp 4 | BL6 | Rag1 KO | male | 5 weeks | pJC (control) | 4 feedings | 21 days | 16 | 5 | 31.3 |
| Exp 4 | BL6 | Rag1 KO | male | 5 weeks | foxA | 7 feedings | 22 days | 10 | 1 | 10.0 |
| Exp 4 | BL6 | Rag1 KO | male | 5 weeks | foxA | 7 feedings | 22 days | 17 | 11 | 64.7 |
| Exp 4 | BL6 | Rag1 KO | male | 5 weeks | foxA | 7 feedings | 22 days | 17 | 12 | 70.6 |
| Exp 4 | BL6 | Rag1 KO | male | 5 weeks | foxA | 7 feedings | 22 days | 19 | 13 | 68.4 |
| Exp 4 | BL6 | Rag1 KO | male | 5 weeks | foxA | 7 feedings | 22 days | 17 | 9 | 52.9 |
| Exp 4 | BL6 | muMT KO | male | 5 weeks | pJC (control) | 4 feedings | 21 days | 17 | 11 | 64.7 |
| Exp 4 | BL6 | muMT KO | male | 5 weeks | pJC (control) | 7 feedings | 21 days | 16 | 2 | 12.5 |
| Exp 4 | BL6 | muMT KO | male | 5 weeks | pJC (control) | 7 feedings | 21 days | 12 | 10 | 83.3 |
| Exp 4 | BL6 | muMT KO | male | 5 weeks | pJC (control) | 4 feedings | 21 days | 16 | 15 | 93.8 |
| Exp 4 | BL6 | wild-type | male | 5 weeks | pJC (control) | 8 feedings | 22 days | 15 | 9 | 60.0 |
| Exp 5 | BL6 | wild-type | male | 5 weeks | pJC (control) | 8 feedings | 22 days | 16 | 9 | 56.3 |
| Exp 5 | BL6 | wild-type | male | 5 weeks | foxA | 8 feedings | 22 days | 18 | 0 | 0.0 |
| Exp 5 | BL6 | wild-type | male | 5 weeks | foxA | 8 feedings | 22 days | 16 | 0 | 0.0 |
| Exp 5 | BL6 | wild-type | male | 5 weeks | foxA | 5 feedings | 22 days | 16 | 3 | 18.8 |
| Exp 5 | BL6 | wild-type | male | 5 weeks | foxA | 5 feedings | 22 days | 18 | 0 | 0.0 |
| Exp | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 5 feedings | 21 days | 7 | 4 | 57.1 |
|-----|-----|---------|------|---------|-------------|-----------|--------|---|---|-----|
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 5 feedings | 21 days | 7 | 4 | 100.0 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 8 feedings | 21 days | 12 | 11 | 91.7 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 8 feedings | 21 days | 19 | 17 | 89.5 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | foxA | 5 feedings | 22 days | 14 | 9 | 64.3 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | foxA | 5 feedings | 22 days | 21 | 16 | 75.0 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | foxA | 8 feedings | 21 days | 16 | 3 | 18.8 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 8 feedings | 22 days | 10 | 6 | 60.0 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 8 feedings | 22 days | 15 | 11 | 73.3 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | foxA | 8 feedings | 22 days | 13 | 1 | 7.7 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | foxA | 8 feedings | 22 days | 15 | 3 | 20.0 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 6 feedings | 21 days | 13 | 13 | 100 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | foxA | 6 feedings | 21 days | 18 | 1 | 6.555555556 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | foxA | 6 feedings | 21 days | 15 | 12 | 80 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 6 feedings | 21 days | 17 | 16 | 94.1176471 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 6 feedings | 21 days | 13 | 13 | 100 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | foxA | 6 feedings | 21 days | 17 | 14 | 82.3529412 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | foxA | 6 feedings | 21 days | 14 | 12 | 85.7142857 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 6 feedings | 21 days | 16 | 12 | 75 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | foxA | 6 feedings | 21 days | 13 | 0 | 0 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 6 feedings | 21 days | 18 | 12 | 66.6666666 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 6 feedings | 21 days | 11 | 8 | 72.2727272 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | foxA | 6 feedings | 21 days | 12 | 1 | 8.333333333 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 6 feedings | 21 days | 14 | 12 | 85.7142857 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 6 feedings | 21 days | 13 | 13 | 100 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 6 feedings | 21 days | 13 | 11 | 84.6153846 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | foxA | 6 feedings | 21 days | 14 | 13 | 92.8571429 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 6 feedings | 21 days | 15 | 7 | 46.6666666 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | foxA | 6 feedings | 21 days | 14 | 9 | 64.2857143 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 6 feedings | 21 days | 14 | 10 | 71.4285714 |
| Exp 5 | BL6 | Rag1 KO | male | 5 weeks | jC (control) | 6 feedings | 21 days | 12 | 6 | 50 |
Table S2. Raw data of worm length measures (millimeters), >3 weeks post-transplantation (Figure 5B)

| Exp | UBC-GFP | wild-type | male | 7 weeks | pJC (control) | 8 feedings | 6 days | 15 | 14 | 93.333333 3 |
|-----|---------|-----------|------|---------|--------------|------------|--------|----|----|----------------|
|     |         |           |      |         |              |            |        |    |    |                 |
|     |         |           |      |         |              |            |        |    |    |                 |
| 4.92 | 6.71  | 3.56   | 2.71 | 4.88   | 6.06         | 3.41       | 2.88   | 9.13 | 8.35 | 2.63          | 2.23 |
| 6.38 | 4.72  | 2.58   |      | 3.55   | 4.62         | 2.56       | 2.75   | 7.36 | 9.30 | 3.32          | 2.55 |
| 4.72 | 5.21  | 3.26   |      | 3.84   | 4.95         | 2.59       | 2.65   | 8.84 | 6.50 | 1.81          | 2.92 |
| 5.46 | 5.64  | 2.93   |      | 5.33   | 4.45         | 2.76       | 2.03   | 7.43 | 9.53 | 1.94          | 3.04 |
| 5.66 | 5.42  | 3.16   |      | 5.37   | 3.78         | 2.22       | 2.58   | 7.75 | 8.39 | 3.47          | 2.33 |
| 4.32 | 6.96  | 3.45   |      | 4.53   | 4.53         | 2.52       | 2.04   | 7.48 | 8.00 | 2.11          | 3.38 |
| 5.65 | 3.82  | 2.26   |      | 3.37   | 5.26         | 3.01       | 2.92   | 5.79 | 9.29 | 2.78          | 2.76 |
| 10.30 | 5.68 | 2.21   |      | 3.58   | 4.01         | 2.67       | 2.65   | 8.71 | 8.26 | 2.72          | 2.57 |
| 9.83 | 5.04  | 3.01   |      | 4.69   | 3.69         | 2.16       | 2.34   | 8.88 | 4.01 | 2.06          | 2.36 |
| 9.87 | 4.69  | 2.75   |      | 6.27   | 3.25         | 2.26       | 1.92   | 6.60 | 6.49 | 3.73          | 2.66 |
| 7.67 | 5.34  | 3.15   |      | 4.59   | 4.00         | 2.45       | 1.94   | 4.99 | 5.71 | 4.62          | 2.47 |
| 8.70 | 7.88  |        |      | 6.48   | 5.73         | 2.51       | 2.55   | 5.60 | 4.48 | 3.36          | 1.92 |
| 7.17 | 8.60  |        |      | 6.26   | 4.31         | 2.97       | 2.69   | 5.21 | 7.44 | 4.37          | 2.12 |
| 6.23 | 8.09  |        |      | 6.45   | 6.50         | 2.37       | 2.65   | 6.95 | 6.16 | 4.07          |       |
| 5.81 | 8.39  |        |      | 6.04   | 5.44         | 2.67       | 1.83   | 8.44 | 6.93 | 3.04          |       |
| 9.05 | 7.86  |        |      | 6.69   | 5.96         | 4.04       | 2.54   | 5.35 | 6.18 | 3.71          |       |
| 8.94 | 8.33  |        |      | 3.30   | 6.41         | 2.62       | 4.03   | 7.45 | 4.85 | 3.34          |       |
| 7.45 | 8.73  |        |      | 5.54   | 5.14         | 2.52       | 2.35   | 5.59 | 5.00 | 3.40          |       |
| 5.55 | 7.82  |        |      | 6.15   | 3.54         | 2.82       | 4.09   | 5.23 | 9.12 | 2.28          |       |
| 8.20 | 5.46  |        |      | 7.72   | 5.72         | 3.87       | 4.43   | 6.95 | 9.68 | 2.82          |       |
| 7.81 | 9.00  |        |      | 4.43   | 5.18         | 3.57       | 2.55   | 6.81 | 7.81 | 3.03          |       |
| 6.91 | 7.75  |        |      | 6.28   | 7.07         | 3.54       | 4.19   | 6.50 | 8.88 | 2.32          |       |
| 8.88 | 7.29  |        |      | 6.19   | 6.24         | 2.87       | 3.14   | 6.32 | 6.72 | 2.91          |       |
| 5.36 | 6.90  |        |      | 6.51   | 7.05         | 3.01       | 2.06   | 9.47 | 8.98 | 3.16          |       |
| 7.92 | 7.81  |        |      | 4.82   | 5.03         | 2.56       | 3.27   | 7.76 | 8.50 |               |       |
| 7.90 | 7.33  |        |      | 6.79   | 5.02         | 4.04       | 3.43   | 7.92 | 7.32 |               |       |
| 6.94 | 7.19  |        |      | 2.97   | 7.90         | 3.07       | 2.51   | 8.52 | 9.46 |               |       |
| 7.46 | 6.88  |        |      | 4.97   | 7.37         | 3.31       | 3.29   | 9.98 | 8.82 |               |       |
| 7.66 | 7.19  |        |      | 4.43   | 7.90         | 2.82       | 4.18   | 8.43 | 8.80 |               |       |
| 5.79 | 8.52  |        |      | 7.75   | 9.29         | 2.66       | 2.60   | 8.43 | 8.83 |               |       |
| 7.48 | 8.27  |        |      | 8.98   | 4.82         | 2.97       | 3.79   | 8.80 | 6.07 |               |       |
|   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|
| 5.81 | 8.30 | 7.39 | 9.74 | 3.21 | 2.85 | 7.78 | 7.80 |
| 6.06 | 7.05 | 7.42 | 6.20 | 2.47 | 2.93 | 8.24 | 6.44 |
| 7.88 | 7.49 | 7.00 | 6.79 | 3.73 | 2.91 | 8.20 | 9.49 |
| 4.19 | 6.80 | 7.78 | 7.29 | 3.74 | 2.86 | 4.51 | 9.65 |
| 5.94 | 7.52 | 6.96 | 7.34 | 2.61 | 4.01 | 8.40 | 8.92 |
| 4.93 | 7.44 | 6.45 | 7.92 | 4.34 | 3.07 | 8.37 | 10.97 |
| 8.20 | 5.50 | 6.88 | 7.87 | 3.69 | 2.89 | 6.40 | 8.80 |
| 6.84 | 5.14 | 8.01 | 6.99 | 5.26 | 2.83 | 6.77 | 10.48 |
| 7.23 | 5.92 | 8.20 | 8.95 | 2.40 | 3.02 | 4.26 | 10.27 |
| 7.82 | 6.55 | 8.79 | 9.38 | 4.54 | 2.50 | 6.36 | 10.70 |
| 6.50 | 6.39 | 4.47 | 7.70 | 4.02 | 2.00 | 6.96 | 10.49 |
| 5.64 | 4.92 | 8.19 | 8.48 | 3.64 | 2.84 | 9.49 | 9.96 |
| 7.08 |   | 7.13 | 7.60 | 3.68 | 2.79 | 8.20 | 9.43 |
| 6.49 |   | 8.26 | 9.04 | 3.68 | 3.29 | 9.22 | 10.77 |
| 5.94 |   | 8.99 | 8.20 | 3.11 | 3.69 | 9.37 | 8.77 |
| 7.56 |   | 8.72 | 6.74 | 3.30 | 2.30 | 8.80 | 5.54 |
| 7.30 |   | 8.14 | 5.78 | 2.88 | 2.37 | 7.81 | 5.86 |
| 6.81 |   | 9.34 | 9.34 | 3.55 | 2.57 | 4.81 | 4.69 |
| 7.69 |   | 8.34 | 8.42 | 2.91 | 2.53 | 9.25 | 5.59 |
| 5.59 |   | 8.49 | 6.93 | 1.98 | 2.54 | 8.97 | 6.31 |
| 7.05 |   | 7.01 | 5.94 | 2.04 | 2.93 | 7.81 | 5.45 |
| 2.35 |   | 8.43 | 6.47 | 3.19 | 2.87 | 8.12 | 6.05 |
| 4.11 |   | 7.24 | 5.40 | 3.87 | 3.00 | 9.09 | 6.64 |
| 5.98 |   | 8.38 | 8.37 | 3.21 | 2.28 | 9.28 |   |
| 6.61 |   | 8.01 | 7.03 | 3.06 | 2.09 | 9.61 |   |
| 6.00 |   | 6.65 | 5.48 | 3.50 | 2.58 | 7.97 |   |
| 5.96 |   | 6.61 | 7.18 | 2.37 | 2.18 | 8.15 |   |
| 5.77 |   | 5.89 | 7.31 | 4.03 | 1.94 | 8.97 |   |
| 6.36 |   | 7.04 | 7.04 | 2.42 | 3.10 | 6.94 |   |
| 6.68 |   | 6.80 | 2.94 | 2.93 | 5.95 |   |   |
| 5.87 |   | 5.05 | 3.77 | 2.14 | 5.55 |   |   |
| 5.96 |   | 6.98 | 3.77 | 2.84 | 3.96 |   |   |
| 6.60 |   | 3.96 | 2.19 | 3.79 |   |   |   |
| 6.11 |   | 3.28 | 6.38 |   |   |   |   |
| 7.70 |   | 3.39 | 6.41 |   |   |   |   |
| 8.37 |   | 3.17 | 4.76 |   |   |   |   |
| 6.56 |   | 2.32 | 3.52 |   |   |   |   |
| 7.55 |   | 3.19 |   |   |   |   |   |
| 7.54 |   | 3.32 |   |   |   |   |   |
Table S3. Oligonucleotide sequence used for this study

| Gene Name | Gene ID   | Purpose | Forward Sequence | Reverse Sequence |
|-----------|-----------|---------|------------------|------------------|
| h2b       | Smp_108390 | ISH     | GCCCTCCTAAAGTTGTCTGG | GACCCACTGTACTCGTCAG |
| tsp2      | Smp_181530 | ISH     | ATGGGCTCTGTGGTGAGT | CCGGCTTTATAGCCAATAAG |
| cathepsin B | Smp_103610 | ISH     | TCAGATTCCAGGAAGAAATGG | TCATCACGACACGCACTAT |
| meg4.1    | Smp_163630 | ISH     | TTTGATATATATGATGTTGTTGA | ATTTTTTGTCAATAGATTTTGG |
| foxA      | Smp_331700 | ISH     | GGACCATACCATTTCTATTG | GAGGTGTTGGAGGAAGAA |
| pla2      | Smp_031190 | ISH     | TGGTGAGAATTAGAGGGCTTTT | ACTTTAGCTTGGGGCCATTTT |
| 7b2       | Smp_073270 | ISH     | GTGCCGATCAATTTGCTTTA | GTGCCGAGAGAAGCACTAT |
| actin     | Smp_307020/307010 | ISH | CAGTGTTCCCTCCATCGTT | GTGAACAATACCAGCAG |
| gtp-4     | Smp_105410 | ISH     | ATCTCTCGTGGGTGTAATCG | CTGTTGACGCTTTGTTGGA |
| foxA      | Smp_331700 | qPCR    | TCACCTCAACAGAAAACA | TCTTCCTTCTGCTATGTTG |
| foxA      | Smp_331700 | qPCR    | CAGGGAAATGTTGAAAATTG | TTGTTGCGTTGGCCATT |
| meg4.1    | Smp_163630 | qPCR    | CAATTACCCAGGAGGAGAAGA | AAAATCGGCTATGGGACTT |
| meg4.1    | Smp_163630 | qPCR    | CAATTACCCAGGAGGAGAAGA | AAAATCGGCTATGGGACTT |
| meg8b     | Smp_172180 | qPCR    | AGAACATCTATTTTGGGAGACG | GTTTGCGTTGGGACCTTT |
| meg14     | Smp_124000 | qPCR    | CCAGGAATACGCCAGAATG | ATCCGCCACAATCTCCAG |
| meg15     | Smp_010550 | qPCR    | CAAGGTTCAAGAAGAATCCACA | TCCGCGTTGATGCTAGGAC |
| pla2      | Smp_031190 | qPCR    | TGGCCGAGTCTTCTTCTTCTC | GGTGCGAGATCATGTTGTA |

Movie S1 (separate file). Recovered foxA RNAi parasites >3 weeks post-transplantation are stunted.

Movie S2 (separate file). Feeding of GFP+ immune cells *in vitro* in control and foxA knockdown schistosomes.